



Public Safety
Broadband Summit

Indoor Location Accuracy using Enterprise Wi-Fi™ in Real-Time

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May 16-17, 2016 | Renaissance Hotel | Washington, DC



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Agenda

- Today
- State of the standards
- Enterprise Real-Time Location
- How trilateration works
- Proposed Architecture

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Where's the
9-1-1 caller?

Located At: Sep 18 7:44:10 PDT
Latitude: +38.89417
Longitude: -77.02028
Hor Uncertainty: 148
Position Source: 135
Status: ✓ Location Found

The screenshot displays the TCS GEM911 web application. The top navigation bar includes the TCS logo, the text 'GEM911™', and links for 'Help' and 'Sign Out (Lance Pitt)'. The main content area is divided into several sections:

- Message Transcript: 1-206-321-7809**: Contains a blue bubble with the text 'I Testing outdoor 911 location' and a green bubble with a checkmark and the text 'You have reached 911. Where is the emergency?'. Below the transcript is a text input field labeled 'Enter text to be sent.' and buttons for 'Send Message' and 'Clear'.
- My Active Sessions**: A table showing active sessions. One session is listed with the phone number '1-206-321-7809' and the name 'Lance Pitt'.
- Map**: A satellite map view showing a location in Washington, D.C. The map includes labels for 'Indiana Ave NW', 'Pennsylvania Ave NW', and '5th St NW'. A red pin is placed on the map, and a yellow callout bubble points to it with the location data.

The location data shown in the yellow callout bubble is:

- Located At: Sep 18 7:44:10 PDT
- Latitude: +38.89417
- Longitude: -77.02028
- Hor Uncertainty: 148
- Position Source: 135
- Status: ✓ Location Found

The bottom of the screenshot shows a Windows taskbar with various application icons and a system clock indicating 12:13 PM on 9/18/2014.

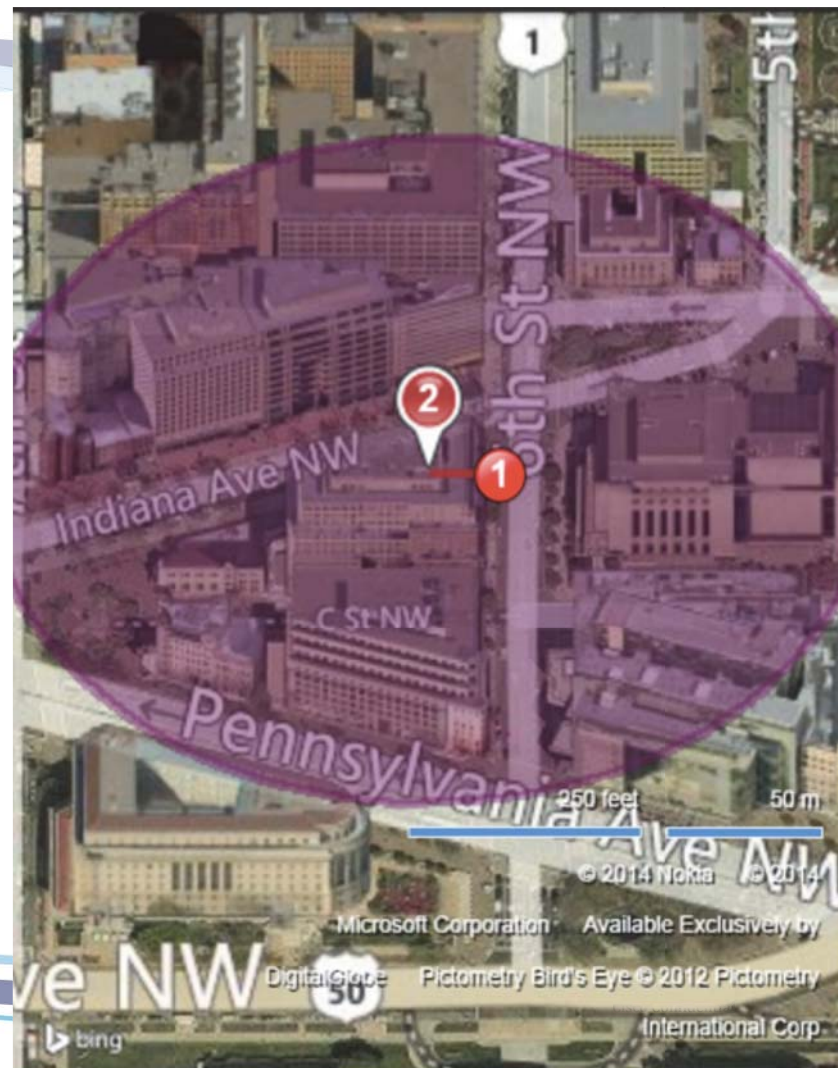
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7 Buildings within the area of
uncertainty, all 8 to 12 stories tall

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A “Dispatchable” location?

- Outdoor location determination technologies deliver an X/Y (latitude/longitude) and a Z (height) coordinate
- X, Y, Z is good for outdoors, but not indoors
- Cisco office at:
 - 601 Pennsylvania Avenue, N.W. North Building
 - Suite 900
 - Washington, District of Columbia, 20004
- Public Safety would get:
 - 38 53.599' N 77 01.216' W
 - Elevation 35 meters?
- **The venue owner/operator MUST be involved in determining dispatchable location**



What floor is 35 meters? Should I go up the elevator on the residential side (left side) or the office side (right side)? Which office or apartment? Could the call have come from the South Building?

NEAD Solution

- The smartphone hears several reference points
 - Wi-Fi access points and Bluetooth Low Energy Beacons
- The serving core network (SCN) queries the smartphone for the reference point identifiers and receive signal strength index (RSSI) for each one
- The serving core network determines which reference points are relevant and queries the NEAD
- The NEAD returns the dispatchable location for each known reference point





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NEAD Solution

Smartphone response

Reference ID	RSSI
0a:5f:64:78:32:bb	-76db
8b:45:de:a3:c4:23	-54db
65:87:3d:f5:89:cd	-67db
3b:2e:56:31:bf:67	-99db
2e:45:bd:87:01:df	-45db
56:bc:d4:f7:63:ab	-82db
76:bc:25:c8:99:f2	-41db
01:b3:5d:93:a7:f5	-61db
35:65:bb:3c:9b:12	-31db

SCN Queries NEAD

Reference ID	RSSI
8b:45:de:a3:c4:23	-54db
2e:45:bd:87:01:df	-45db
76:bc:25:c8:99:f2	-41db
35:65:bb:3c:9b:12	-31db

NEAD Response to SCN

Reference ID	Dispatchable Location	GeoCode
8b:45:de:a3:c4:23	123 Main St., 2 nd Floor, Anytown, USA	24.55 -81.56
2e:45:bd:87:01:df	125 Main St., Anytown, USA	24.55 -81.56
76:bc:25:c8:99:f2	123 Main St., 2 nd Floor, Anytown, USA	24.55 -81.56
35:65:bb:3c:9b:12	123 Main St., 3 rd Floor, Anytown, USA	24.55 -81.56

The NEAD location is the dispatchable location of the reference point! The caller is within proximity of the reference point.

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Enterprise Real-Time Location

- Enterprises are reluctant to reveal a 'map' of their data network
- Security - Internal data networks are the lifeblood of a company
- Privacy – Enterprises log when their assets are used to track someone
- Maintaining the same information in multiple places is not ideal
- Enterprises ARE interested in the safety of their customers and employees
- Enterprises will allow queries to their networks in real-time during an emergency
- The incentive for Enterprises is that they will know when someone dials 9-1-1 from within their facility

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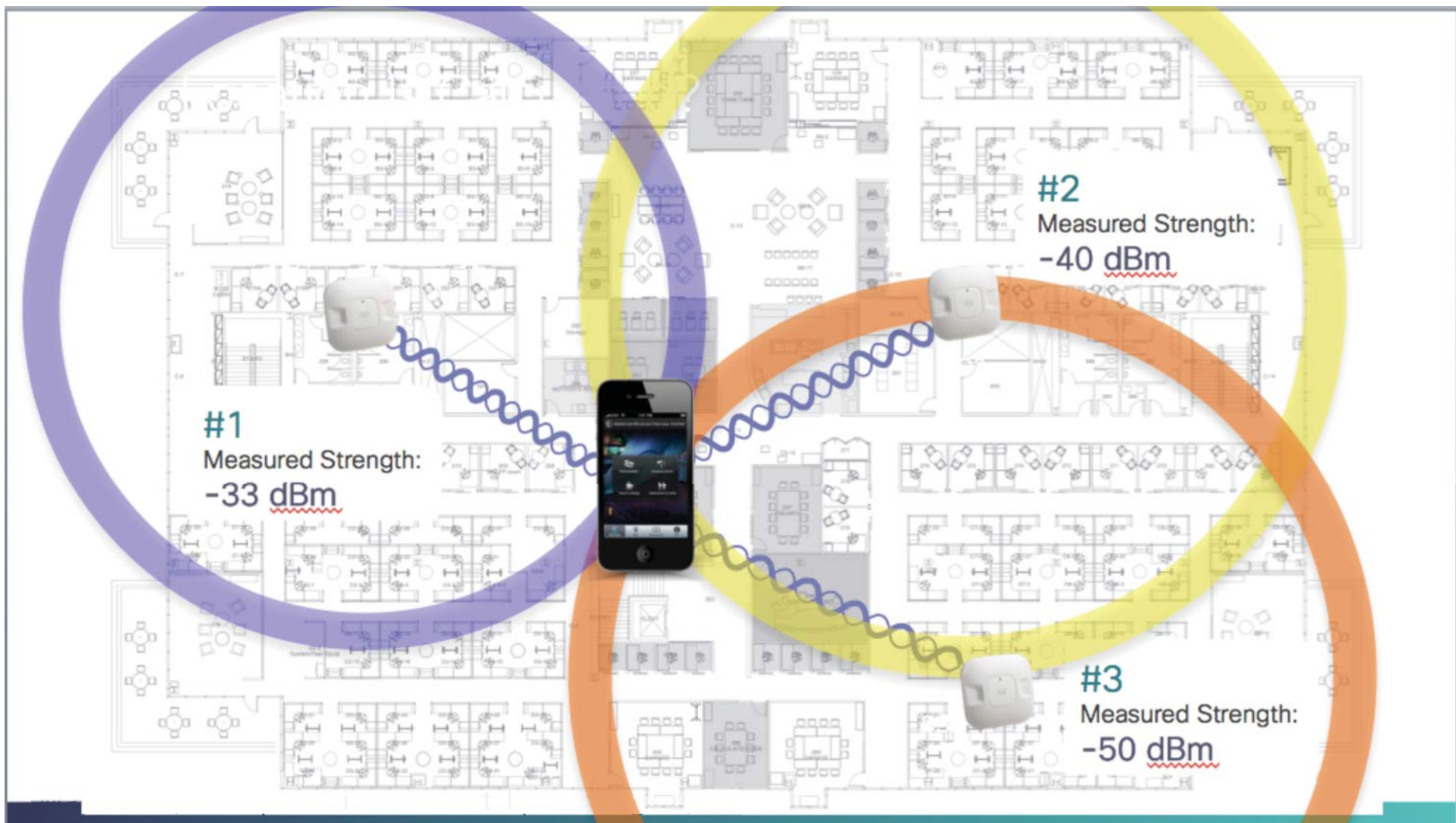


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Enterprise Real-Time Location

- Enterprise Wi-Fi systems use 'trilateration' to locate a device
- Trilateration requires knowing 'exactly' where the Wi-Fi access point is located.
- Access Points are placed on a grid map
- Devices are located using RSSI as seen by the APs
 - AoA and TDoA are in early implementations
- Trilateration determines where the device is located on the grid
- The resultant dispatchable location is determined by the section of the grid the device is located

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TCS GEM911™

Help Sign Out (kcs0 user one)

Unassigned Queue
1-206-661-1895 (1) 43340 min(s)

End Session

Font Size: + -

I need help

1-303-766-7777 Fri Oct 03 2014 14:15:31 PDT

✓ 911, what's your emergency ?

Fri Oct 03 2014 14:16:25 PDT kcs0 user one

Fell down some stairs

1-303-766-7777 Fri Oct 03 2014 14:17:04 PDT

✓ I have you at 2250 East President George Bush
Is this correct?

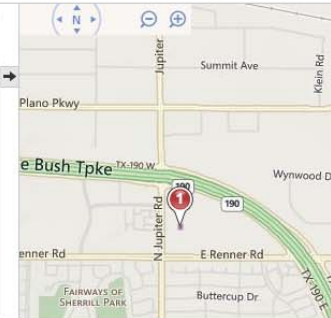
Fri Oct 03 2014 14:19:23 PDT kcs0 user one

My Active Sessions

▶ 1-303-766-7777 kcs0 user one

Transfer

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indoor location

Campus: Richardson TX 75082
Building: Cisco Building 5
Floor: 2250 East PGBT First Floor
Uncertainty Radius: 4.88 meters
Zoom: + -



Campus: Richardson TX 75082
Building: Cisco Building 5
Floor: 2250 East PGBT First Floor
Uncertainty Radius: 4.88 meters

Caller

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The ultimate for a First Responder



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Enterprise Real-Time Location

- Populates the NEAD with Enterprise Access Points
 - An R&O metric
 - A URL is used to point to the External Location Service
- Provides location of the caller
 - vs. location of the reference point
 - Enterprise Wi-Fi systems are engineered for device location
 - Reduces guess-work
- Provides Enterprise S&S indication of a 9-1-1 call on their campus/venue
- Maintained by the External Location Service, an entity that understands both Enterprise and Public Safety needs

Current Architecture

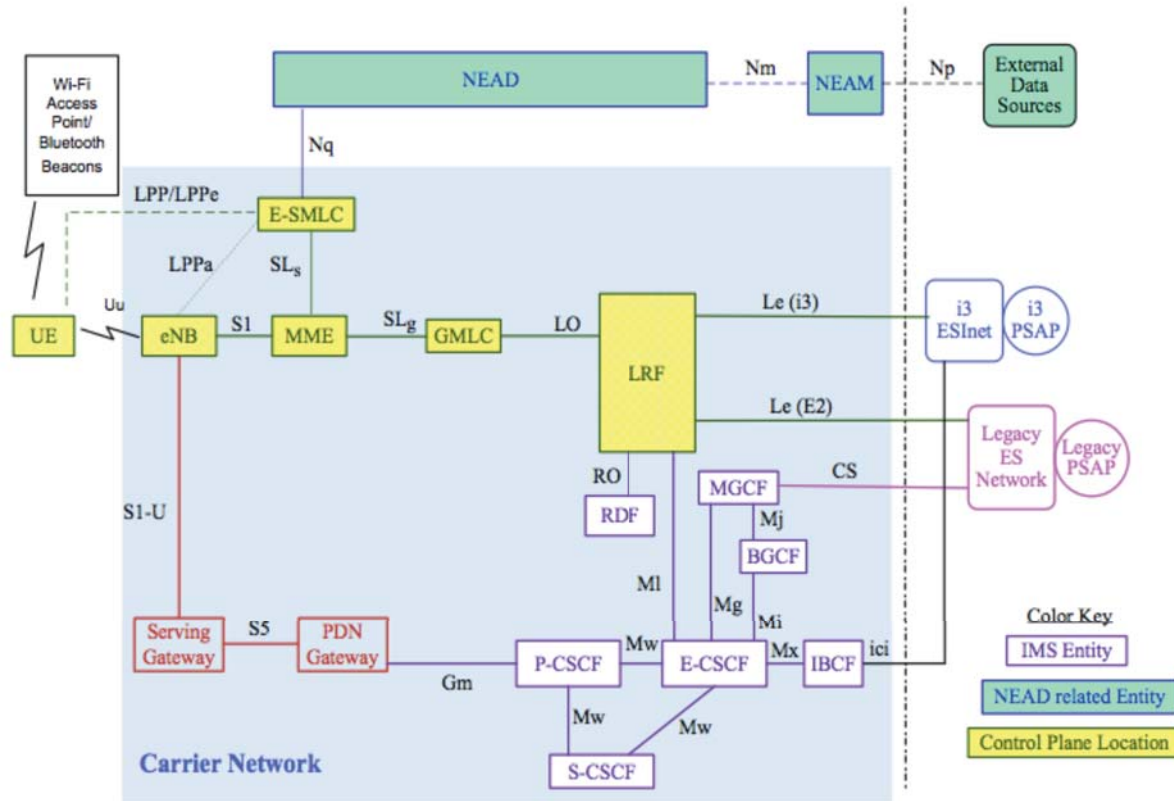
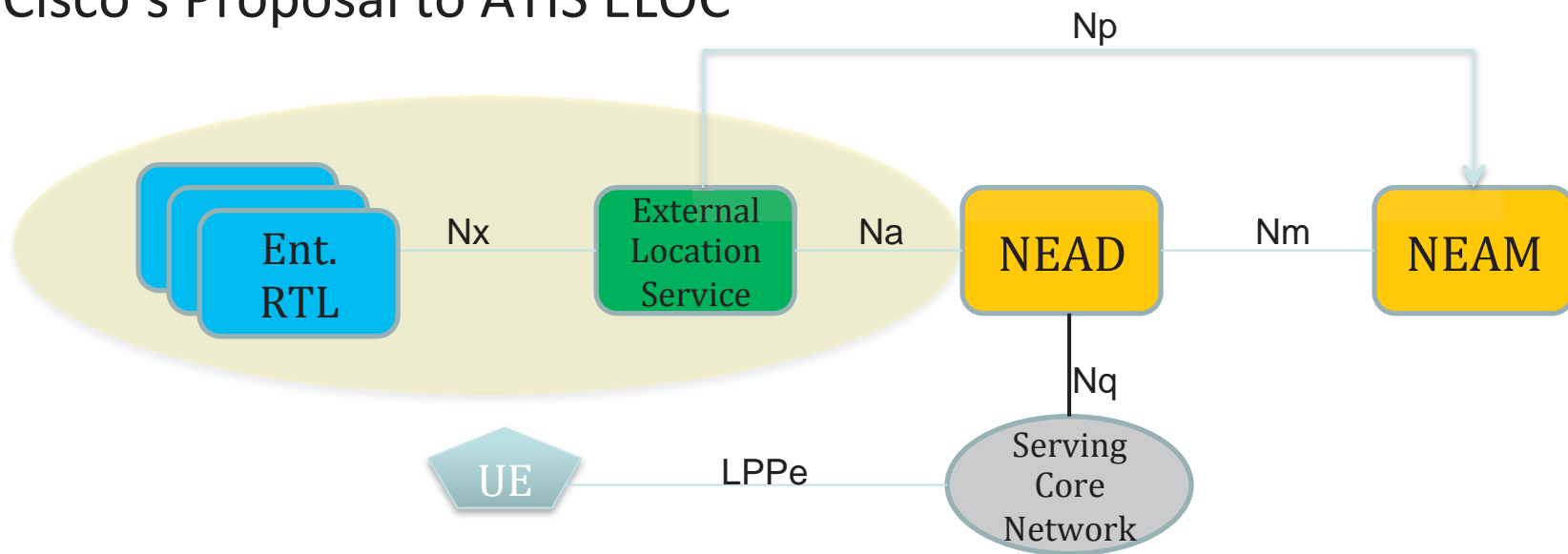


Figure 7.4 - Architecture for Heightened Accuracy Location with LTE Access and Control Plane Location

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Cisco's Proposal to ATIS ELOC





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UE

Serving
Core
Network

NEAD

NEAM

External
Location
Service

Ent.
RTL

Caller dials 9-1-1

SCN queries UE via
LPPe for APs heard
and UE MAC

SCN queries NEAD
with AP MAC, UE
MAC

NEAM populates
NEAD with AP MAC
& CMA & URL

DB lookup yields URL
NEAD queries ELS with
AP MAC, UE MAC

ELS populates
NEAM with AP MAC
& CMA & URL

ELS queries
Enterprise for AP
MACs

ELS queries
Enterprise RTL with
UE MAC

Location returned

Validated Location &
Geocode returned

Validated Location &
Geocode returned

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Questions?

Thank You!

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